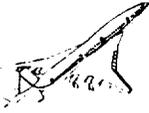
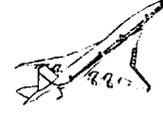


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HSR HIGH-LIFT TECHNOLOGY

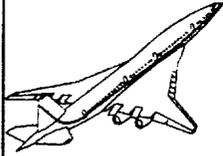


High Lift Technology Overview

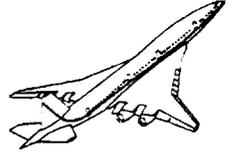
Z. T. Applin

**Presented at the
First NASA/Industry HSR Configuration Aerodynamics
Workshop**

**February 27-29, 1996
Langley Research Center
High-Lift Technology
Integrated Technology Development Team**



OUTLINE

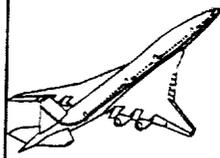


- **PCD1 Review**
 - Program content
 - Models
 - High-lift system downselect
 - Viscous USG development

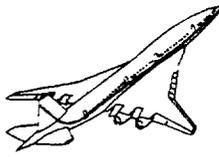
- **PCD2 Overview**
 - Planned program

- **Summary**

PCD2 Overview

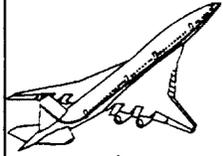


PCD2 Milestones

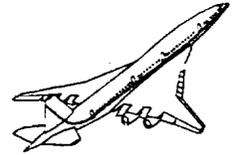


4.3.2 High-Lift Technology

TASKS	FY	1996	1997	1998	1999
Program Milestones		▲ Technology Concept			Technology Configuration ▲
Level II Milestones		△ High-Lift Concept Selection			High-Lift Wind Tunnel Evaluation △
		HEAT 1A Defined		High-Lift System Update	Tools and Methods Assess. Tech. Concept Final Assess.
Level III Milestones		▲▲ Tech. Concept HL Geom. Defined	▲▲ Tech. Concept Prelim. Assess.	▲▲ HL/PAJ Aerodynamic Assess.	
4.3.2.1 Technology Concept Assessment		Tech. Concept HL Geom. Defined	Def. S&C Aero. Requirements	Tech. Concept Prelim. Assess.	Tech. Concept Final Assess.
4.3.2.2 High-Lift System Concept Design			Assess. High-Lift System Refinements	High-Lift System Update	
4.3.2.3 Propulsion/Airframe Integration		HEAT 1 Aerodynamic Assess.			HEAT 1A Aerodynamic Assess.
4.3.2.4 High-Lift Tools and Methods Development		Auto. Adapt. of Viscous USG	Support/Wall Interference	Ground Effects Methodology Assess.	Full-Scale Prediction Methodology
4.3.2.99 Task Coordination and Planning			BL Trans. Technique Recom.	Viscous USG Tech. Concept Assess.	



PCD2 WBS Description



4.3.2.1 Technology Concept Assessment

Develop an efficient high-lift system for the Technology Concept HSCT aircraft configuration and provide an assessment of the low-speed aerodynamic performance and handling characteristics.

4.3.2.2 High-Lift System Concept Design

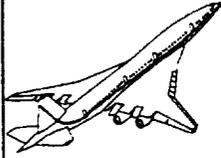
Design and evaluate refinements to the Technology Concept high-lift system in order to identify and develop areas for potential improvement which will be required in order to meet the established performance improvement goals.

4.3.2.3 Propulsion/Airframe Integration

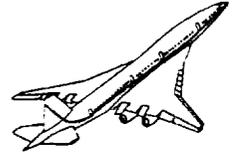
Evaluate the installation effects of the propulsion system on the low-speed aerodynamic performance and handling characteristics both in and out of the influence of the ground.

4.3.2.4 Tools and Methods Development

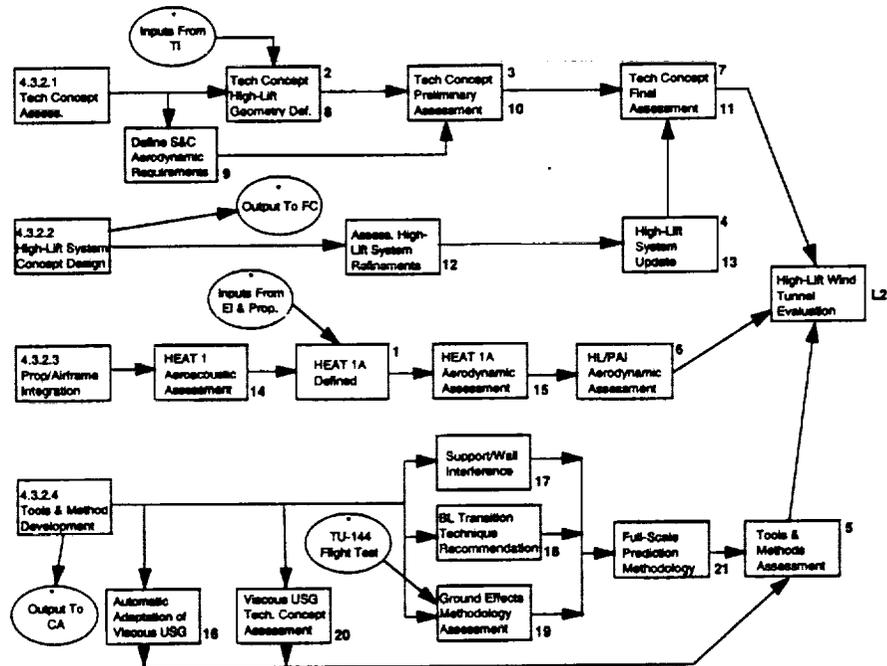
Develop the tools and methods required for the accurate assessment of the full scale aerodynamic performance of the Technology Concept HSCT configuration.



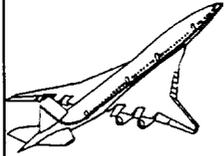
PCD2 Logic Flow



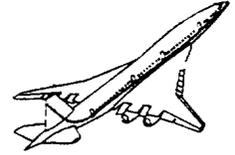
4.3.2 High Lift Technology Logic Flow Diagram



Note: Number at upper corner is Level 3 milestone number.
 Number at lower corner is Level 4 milestone number.
 * Interfaces with other program elements described in sections 3.14-15.



PCD2 Logic Description



4.3.2.1 Technology Concept Assessment

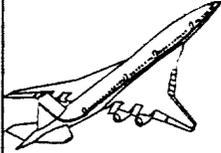
Milestone Number

Level 3

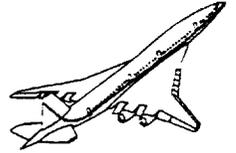
- | | |
|---|--|
| 2 | Technology Concept High-Lift Geometry Defined (May 15, 1996) <ul style="list-style-type: none">- high-lift system geometry defined in preparation for model fabrication |
| 3 | Technology Concept Preliminary Assessment (Jul 15, 1997) <ul style="list-style-type: none">- early performance and S&C assessment of Tech. Concept |
| 7 | Technology Concept Final Assessment (Sep 15, 1998) <ul style="list-style-type: none">- performance and S&C assessment of Tech. Concept leading to Tech. Config. |

Level 4

- | | |
|----|--|
| 8 | Technology Concept High-Lift Geometry Defined (May 15, 1996) <ul style="list-style-type: none">- high-lift system geometry defined in preparation for model fabrication |
| 9 | Define Stability and Control Aerodynamic Requirements (Jul 15, 1996) <ul style="list-style-type: none">- develop aerodynamic coefficient requirements based on desired handling qualities |
| 10 | Technology Concept Preliminary Assessment (Jul 15, 1997) <ul style="list-style-type: none">- early performance and S&C assessment of Tech. Concept |
| 11 | Technology Concept Final Assessment (Sep 15, 1998) <ul style="list-style-type: none">- performance and S&C assessment of Tech. Concept leading to Tech. Config. |

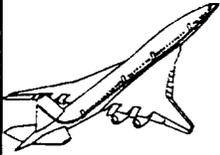


PCD2 Logic Description

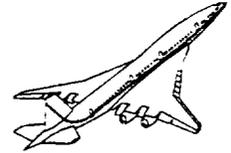


4.3.2.2 High-Lift System Concept Design

Milestone Number	Level 3
4	High-Lift System Update (Sep 15, 1997) <ul style="list-style-type: none">- interim update of high-lift system
	Level 4
12	Assessment of High-Lift System Refinement (Mar 17, 1997) <ul style="list-style-type: none">- assessment of viable refinements to the high-lift system
13	High-Lift System Update (Sep 15, 1997) <ul style="list-style-type: none">- interim update to Technology Concept high-lift system



PCD2 Logic Description



4.3.2.3 Propulsion/Airframe Integration

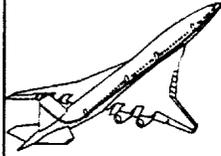
Milestone Number

Level 3

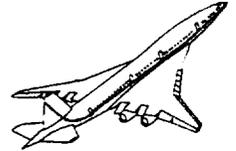
- | | |
|---|---|
| 1 | HEAT 1A Defined (Apr 30, 1996) <ul style="list-style-type: none">- definition of the technical objectives and configuration of the HEAT 1A model and subsystems |
| 6 | High-Lift/Propulsion Airframe Integration Aerodynamic Assessment (Sep 15, 1998) <ul style="list-style-type: none">- assessment of aerodynamic characteristics of current-generation HSCT |

Level 4

- | | |
|----|---|
| 14 | HEAT 1 Aeroacoustic Assessment (Apr 15, 1996) <ul style="list-style-type: none">- complete analysis of HEAT 1 aero/acoustic/propulsion test data |
| 15 | HEAT 1A Aerodynamic Assessment (Jul 15, 1998) <ul style="list-style-type: none">- complete analysis of HEAT 1A airframe/propulsion integration test data |

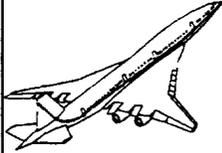


PCD2 Logic Description

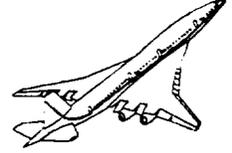


4.3.2.4 Tools and Methods Development

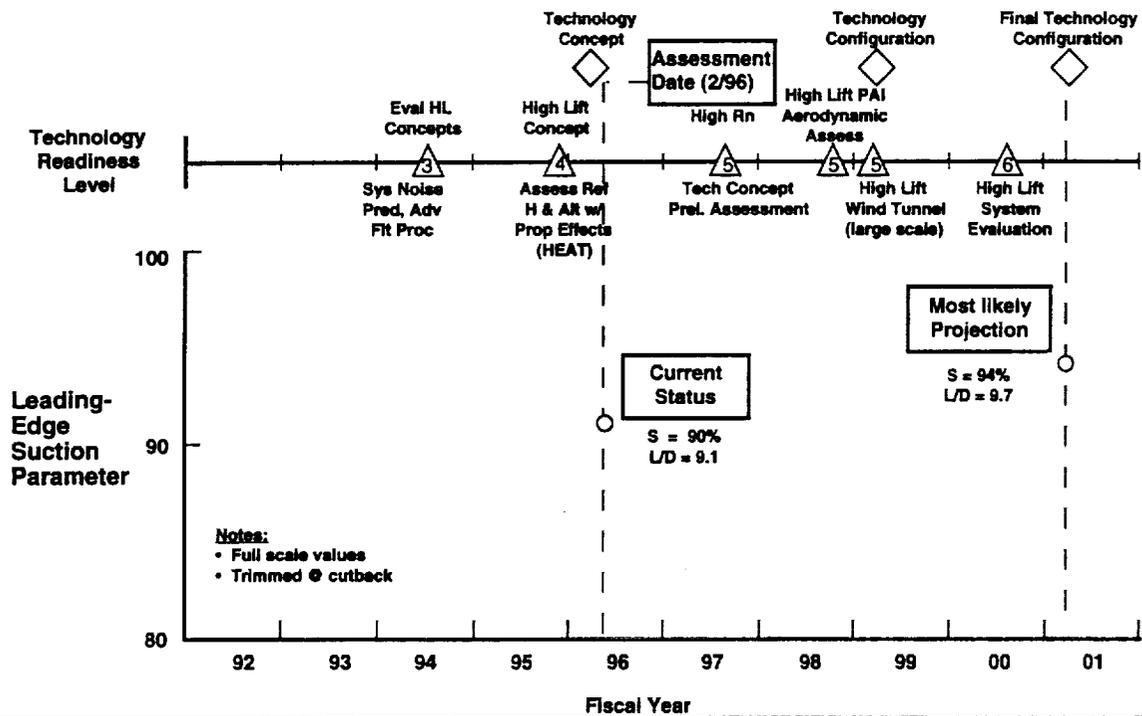
Milestone Number	Level 3
5	Tools and Methods Assessment (Jun 15, 1998) <ul style="list-style-type: none">- assessment of tools and methods available for analysis and full-scale prediction of low-speed characteristics of the HSCT
	Level 4
16	Automatic Adaptation of Viscous Unstructured Grid (USG) Method (Oct 15, 1996) <ul style="list-style-type: none">- development of automatic grid adaptation capability for USG method
17	Support/Wall Interference (Dec 16, 1996) <ul style="list-style-type: none">- method for correcting wind tunnel data for support and wall interference effects
18	Boundary-Layer Transition Technique Recommendation (Apr 15, 1997) <ul style="list-style-type: none">- verified technique for ensuring proper B.L. transition location
19	Ground Effects Methodology Assessment (Jul 15, 1997) <ul style="list-style-type: none">- assessment of methods for predicting ground effects from wind-tunnel data
20	Viscous USG Technology Concept Assessment (Dec 15, 1997) <ul style="list-style-type: none">- application of viscous USG method to assess Technology Concept
21	Full-Scale Prediction Methodology (May 15, 1998) <ul style="list-style-type: none">- method for extrapolation of wind tunnel results to full-scale conditions

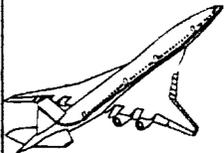


High Lift Technology Metrics

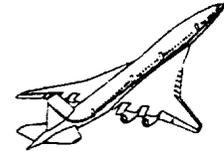


Technical Performance & Technology Readiness Level



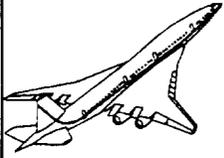


High Lift Technology Models/Facilities

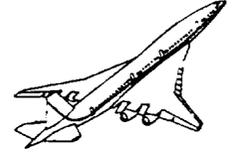


WBS 4.3.2 High-Lift Technology Model/Facility Utilization

FY	1996				1997				1998				1999
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
NASA Ames													
12-Foot													
4% M2.4-7a													
4% Tech. Concept													
10/14 2wks													
40- by 80-Foot													
13.5% Semispan Ref. H													
10/1 4wks													
6/16 4wks													
NASA Langley													
14- by 22-Foot													
6% Ref. H													
4% M2.4-7a													
4% Tech. Concept													
1/8 4wks													
6/2 4wks													
12/6 2wks													
2/3 4wks													
6/2 4wks													
12/16 4wks													
NIE													
2.2% Ref. H													
12/11 6wks													
7/1 4wks													
9/16 4wks													
2/3 4wks													
NASA Lewis													
LR1													
HSCT Wing Panel													
4/1 3wks													



Summary



- **High-lift system performance will have a large impact on airplane noise and weight.**
- **Successful completion of PCD1 activities provided greater understanding of aerodynamic characteristics and configuration features important to high-lift system performance including:**
 - Reynolds number effects (Ref. H)
 - Propulsion/airframe integration effects
 - Planform effects, canard/3-surface, alternate high-lift concepts, etc.
- **PCD2 plans are aimed at achieving technology development performance goals and increasing technology readiness level for Technology Concept.**

